

Chapter 6.7 ESTUARY AND COASTAL ASSESSMENT AND PROGRAM INITIATIVES

The Commonwealth of Virginia has 120 miles of Atlantic Ocean coastline and approximately 2,500 square miles of estuary. This resource has a prominent place in both Virginia's history and culture. It is valued for its commercial fishing, wildlife, sporting, and recreational opportunities, as well as its commercial values in shipping and industry. In the late 1970's, adverse trends in water quality and living resources were noted and prompted creation of the Federal-Interstate Chesapeake Bay Program (CBP).

Through participation in the CBP and implementation of special state initiatives, Virginia maintains a firm commitment to rehabilitate and wisely manage its estuarine resources. Because nearly all of Virginia's estuarine waters flow into the Chesapeake Bay, the activities of the CBP apply to Virginia's estuaries in general. This chapter provides an overview of the state's strategies and activities intended to cleanse and preserve the Chesapeake Bay and its tidal tributaries.

Chesapeake Bay Program Initiative

In 1983, Virginia, Maryland, Pennsylvania, the District of Columbia, the Environmental Protection Agency, and the Chesapeake Bay Commission formally agreed, by signing a Chesapeake Bay Agreement, to undertake the restoration and protection of the Bay using a cooperative Chesapeake Bay Program approach. This approach established specific mechanisms for its coordination among the Program participants. Recognizing the need for an expanded and refined commitment to the Bay's restoration, a new Bay Agreement was signed in 1987. The new agreement contained goals and priority commitments in six areas: Living Resources; Water Quality; Population Growth and Development; Public Information, Education, and Participation; Public Access; and Governance.

A key Water Quality goal established by the 1987 Agreement was to reduce, by the year 2000, the annual nutrient load of nitrogen and phosphorus entering the Bay from controllable sources by 40%. The starting point, or "baseline", for this reduction effort was the sum total of 1985 point source loads (discharges from significant municipal and industrial treatment plants) and non-point source loads (runoff from agricultural, forested and urban areas) in an average rainfall year. Achieving this 40% reduction was expected to improve dissolved oxygen levels and water clarity conditions in the Bay, which in turn would help improve the habitats and health of living resources.

In 1992, the nutrient reduction goal was reevaluated using information from a variety of sources, most notably water quality monitoring and modeling programs. As a result, the Bay Program reaffirmed its commitment to the 40% goal in a set of 1992 Amendments to the Bay Agreement. The Amendments also directed that tributary-specific nutrient reduction strategies be developed to achieve and maintain the goal, as well as to protect and improve aquatic habitats within those rivers.

On June 28, 2000, the Chesapeake Executive Council signed Chesapeake 2000 – a new and far-reaching agreement that will guide Maryland, Pennsylvania, Virginia, the District of Columbia, the Chesapeake Bay Commission, and the U.S. Environmental Protection Agency (EPA) in their combined efforts to restore and protect the Chesapeake Bay.

Chesapeake 2000 outlines 93 commitments detailing protection and restoration goals critical to the health of the Bay watershed. From pledges to increase riparian forest buffers, preserve additional tracts of land, restore oyster populations and protect wetlands, Chesapeake 2000 strives toward improving water quality as it is the most critical element in the overall protection and restoration of the Bay and its tributaries. At the same time Bay Program partners were developing the new Bay Agreement, the Chesapeake Bay and many of its tidal tributaries were placed on the "impaired waters" list. This action is normally followed by the development of a "total daily maximum load" (TMDL) through a regulatory process.

Chesapeake 2000 seeks to avoid regulatory approaches by achieving water quality improvements prior to the timeframe when a Baywide TMDL would need to be established. To accomplish this goal, Chesapeake Bay Program partners are developing a new process for setting and achieving nutrients and sediment load reductions necessary to restore Bay water quality. This process requires Bay Program partners to continue to build on previous nitrogen and phosphorus reduction goals, but instead of

measuring improvement against broad percentage reduction goals, they must now establish and meet specific water quality standards. This new process will also incorporate elements traditionally found in the regulatory TMDL process, such as criteria, standards and load allocations, but also would be developed and applied through a cooperative process involving six states, the District of Columbia, local governments and involved citizens. For the first time, Delaware, New York and West Virginia are formally partnering with EPA, the Bay states and the District to improve water quality watershed-wide.

In Virginia, the Department of Environmental Quality (DEQ) has primary responsibility for point source discharge issues, bringing together programs in the areas of surface and groundwater protection, waste management, and air pollution control. The Department of Conservation and Recreation (DCR) has the lead for nonpoint source control programs. Other state agencies that provide vital support include: Game and Inland Fisheries, Forestry, Health, Chesapeake Bay Local Assistance, Marine Resources Commission, Agriculture and Consumer Services, along with higher education units Virginia Institute of Marine Science and Old Dominion University.

Virginia's Tributary Strategy Program

Reducing nutrient and sediment loads to receiving waters through the implementation of tributary strategies remains a high priority for Virginia. Through the previous tributary strategy program, substantial resources have been dedicated to this effort and significant progress already has been achieved toward the original 40% nutrient reduction goal in the Shenandoah and Potomac River basins. Previous tributary strategies implemented for Virginia's Eastern Shore and the James, Rappahannock and York river basins did not show quite as impressive reductions in nutrients (due in part to limited funding opportunities). Had funding been in-place and strategies been fully implemented, similar reductions and water quality benefits could have been expected in those basins as well. In March 2003, Virginia agreed to new annual load allocations for nitrogen and phosphorus and for the first time developed allocations for sediment loading. These allocations set a goal of 51.4 million pounds/yr for nitrogen, 6 million pounds/yr for phosphorus and 1.9 million pounds/yr for sediments. The existing tributary strategies will be revised by April 2004 to reflect these new allocations.

Tributary strategies are water quality plans that are cooperatively developed with stakeholders in each river basin. Agencies under the Secretary of Natural Resources work closely with local governments, Planning District Commissions, Soil and Water Conservation Districts, sanitation and wastewater authorities, conservation and river-user groups, agricultural producers, industries, and others to develop strategies that are practical, equitable, and cost-effective. Reduction goals are established based on the best available scientific information and water quality model results (i.e. the basin allocations); and are implemented through best management practices. These point source and nonpoint source nutrient control practices are then eligible for cost-share funding through Virginia's Water Quality Improvement Fund (WQIF).

Details on the tributary strategy program can be found in the Secretary of Natural Resources report: "2003 Annual Report on Implementation of the Chesapeake Bay Agreement, Status of the Tributary Strategies, and Status of Water Quality for Virginia's Chesapeake Bay and Tributaries". A brief overview is provided in the following sections of this report. Additionally, on December 9, 2003, Governor Warner announced he was directing the Virginia Department of Environment Quality to begin the regulatory process to set technologically based numerical limits for nutrients in discharge permits to begin a comprehensive nitrogen reduction strategy

Shenandoah-Potomac Tributary Nutrient Reduction Strategy

In December of 1996, Virginia completed the Shenandoah and Potomac River Basin Tributary Nutrient Reduction Strategy (Strategy). The Strategy was the culmination of three years of cooperative work among several of Virginia's Natural Resources agencies, local government officials and other interested citizens and stakeholders. The Strategy outlines point and nonpoint source management actions that were needed to achieve the 40% nutrient reduction goal for this river basin by the deadline of December 31, 2000. Implementation rates for these practices have been very high in response to the cost-share program that was established under the Water Quality Improvement Act. As a result,

implementation of point source and nonpoint source management practices has taken us a major step closer to meeting the challenging 40% nutrient reduction goal.

Point Source Nutrient Reduction Actions in the Shenandoah/Potomac Basin

Progress continues to be made on point source nutrient reduction projects under the provisions of the signed WQIF grant agreements in the Shenandoah and Potomac River basins. These sixteen projects account for approximately \$75.4 million in cost-share (50%) for the design and installation of nutrient reduction systems. To date, over \$64.8 million has been reimbursed to these grantees for work accomplished. Once operational, these systems (designed for an annual average of 8.0 mg/l TN) will remove an estimated 7,407,000 pounds of nitrogen and 241,300 pounds of phosphorus per year.

Nonpoint Source Nutrient Reduction Actions in the Shenandoah/Potomac Basin

Non-point implementation activities identified in the Shenandoah-Potomac tributary strategy were completed in December of 2000. Based on the sign-up through December 2000 for cost-share to install nonpoint source Best Management Practices (BMP's), a 40.9% reduction in annual controllable nitrogen loads and a 40.7% reduction of the controllable phosphorus load were achieved.

The principal nonpoint source components of the strategy included agricultural BMP's and agricultural nutrient management planning. The agricultural BMP's were implemented through Virginia's Cost-Share Program, which is administered locally by Soil and Water Conservation Districts. Nutrient management planning was accomplished through a combined effort of Department of Conservation and Recreation nutrient management staff, local soil and water conservation district staff and private certified nutrient management planners.

Nutrient and Sediment Reduction Strategies for Virginia's Lower Chesapeake Bay Tributaries

Implementation of Virginia's lower Bay tributary strategies is ongoing. Point source nutrient reduction projects are proceeding under 8 signed WQIF agreements, awarding \$23.3 million in cost-share. All but one of these projects have been awarded based on performing to 8.0 mg/l for TN on an annual average and, once on-line, these systems will remove about 6.29 million pounds of nitrogen and 1,400 pounds of phosphorus annually. It is anticipated that this implementation phase will lead to specific improvements in the water quality problems that have been identified in each tributary.

Mid Atlantic Integrated Assessment (MAIA)

In 1997 and 1998, the U.S. Environmental Protection Agency in partnership with other Federal and state programs conducted research on an integrated monitoring approach for Mid-Atlantic estuaries (<http://www.epa.gov/emap/maia/>). The geographic area covered included the watersheds of the Delaware Estuary, Chesapeake Bay, Delmarva coastal bays, and Albermarle-Pamlico System. The objectives of this research program were to: (1) characterize the ecological condition of the Mid-Atlantic estuaries using a common set of measurements applied over the entire area, (2) focus research on small estuarine systems to determine better monitoring approaches for these critical systems, and (3) to demonstrate that effective partnerships can be established among Federal and state agencies with estuarine responsibilities in the pursuit of scientific data for resource management purposes. Data from this sampling program were used in this 305b report.

Over 700 sampling sites were visited during the summer of 1997, with the emphasis at the majority of the sites on water and sediment quality. These included sites selected using statistical survey designs (random selection) and fixed station survey designs (targeted selection). Since one of the objectives of the research program was to further investigate small estuarine systems, more emphasis was placed on these systems by spatial intensification of sampling in selected areas. Over 500 sampling sites were selected for monitoring during the summer of 1998, with fish trawling conducted at over 120 sites. These also include sites selected using statistical survey designs (random selection) and fixed station survey designs (targeted selection).

A unique aspect of this collaborative research program was the sampling for a set of consistent measurements across the Mid-Atlantic estuaries. The list of the parameters collected was developed in conjunction with Federal, state, and county authorities to address critical scientific issues affecting these estuaries. These parameters focus on many aspects of the estuarine biotic community, both plants and animals, as well as provide important information about the exposure to stresses in the estuarine environment. In general, the measurements include data on fish and shellfish, benthic (bottom-dwelling) community structure, water quality, toxic contaminants in bottom sediment, and sediment toxicity.

Toxics, Pollution Prevention, and Businesses for the Bay

The “Toxics 2000 Strategy” of the Chesapeake 2000 Agreement recommits to the 1994 Toxics Strategy goal of a “Chesapeake Bay free of toxics by reducing or eliminating the input of chemical contaminants....” The strategy embraces the concepts of voluntary “pollution prevention”, “reduction”, and “elimination” as the means to reaching this goal. Furthermore, the strategy relies heavily upon the expected achievements of participants in the voluntary pollution prevention program Businesses for the Bay.

Pollution prevention (or P2) includes a hierarchy of activities and techniques to reduce or eliminate wastes and/or reduce the toxicity of chemicals used at the source of production. P2 was embraced by the Chesapeake Bay’s Executive Council because many P2 techniques not only decrease chemical discharges and waste generation, but also result in increased production efficiency and reduced waste disposal costs for businesses. For this reason, business and industry have been the leaders in developing many P2 techniques and are proponents of this voluntary approach to eliminating or reducing the generation of wastes.

Working closely with representatives from business and industry, the EPA’s Chesapeake Bay Program and the Pollution Prevention programs of the Bay states helped craft Businesses for the Bay, a voluntary pollution prevention program designed to encourage industry to adopt pollution prevention principles. The Executive Council approved the program in October 1996 and Virginia kicked off its program in January 1997.

Membership in Businesses for the Bay is open to all businesses and other facilities in the Bay watershed, including federal, state, and local government facilities. Each participating facility annually develops its own P2 goals and reports back on its progress of the previous year’s efforts. The program also supports a business-to-business mentoring program, and individual “experts” from member facilities have volunteered to provide assistance to others. Members not only benefit from cost savings and increased efficiencies, but also from positive publicity, increased patronage, access to mentoring services, and eligibility for annual awards from the Executive Council.

Businesses for the Bay Goals

As mentioned, the new Toxics 2000 Strategy includes challenging numeric goals for Businesses for the Bay:

- Businesses for the Bay participants will prevent or recycle a total of one billion pounds of hazardous substances between 1999 and 2005.
- By 2005, Businesses for the Bay will have 1,000 participants throughout the watershed; and 50% will be small businesses with fewer than 100 employees.
- By 2005, Businesses for the Bay will have a total of 300 individuals volunteer as mentors to provide P2 assistance; and these mentors will annually conduct 500 interactions with those in need.

To date, there are more than 540 participants and 120 mentors in Businesses for the Bay. In 2002, participants reported approximately 621 million pounds of waste reduction and recycling, and nearly \$259 million in cost savings due to pollution prevention efforts. Virginia accounts for 241 Businesses for the Bay members and 54 of its mentors. In 2002, Virginia members achieved reductions of 16.7 million pounds and cost savings of \$664,000.

The Virginia DEQ's Office of Pollution Prevention actively promotes Businesses for the Bay through a variety of approaches, including presentations, directed mailings, and site visits to its member facilities. In support of the efforts of Businesses for the Bay, Virginia has pursued partnerships and reciprocal agreements with other P2 initiatives, such as the Virginia Environmental Excellence Program, the Elizabeth River Project, the Virginia Clean Marinas Program, and the DEQ/Department of Defense P2 Partnership. Virginia DEQ also coordinates Businesses for the Bay mentoring activities through the Virginia Mentoring Network on-line database at www.deq.virginia.gov/vmn/vmnindex.htm.

Awards

Each year, the Council recognizes businesses and other entities that have made significant voluntary achievements in pollution prevention and served as leaders in the Bay's restoration efforts. This year, the Executive Council presented 14 awards in various categories, and Virginia entities received 8 of those awards. The following awards were presented to Virginia entities:

Large Business

- Outstanding Achievement Award: Infineon Technologies in Sandston
- Significant Achievement Award: Brown & Williamson Tobacco Corp/Hanmer Division in Chester

Local Government

- Outstanding Achievement Award: Southeastern Public Service Authority in Chesapeake
- Significant Achievement Award: City of Newport News
- Significant Achievement Award: City of Manassas Maintenance Garage & Wastewater Treatment Plant

Federal Government

- Outstanding Achievement Award: Fort A. P. Hill

Federal Government Regional Operation

- Outstanding Achievement Award: Commander Navy Region Mid-Atlantic in Norfolk
- Co-Mentors of the Year: Dave Gunnarson and Harry DeLong of Lockheed Martin in Manassas

For more information, please access the Businesses for the Bay website at www.b4b.org. You may also contact VA DEQ's Keith Boisvert at 804-698-4225 or kaboisvert@deq.virginia.gov; or you may contact the Businesses for the Bay Coordinator Marylynn Wilhere at 1-800-YOURBAY or wilhere.marylynn@epa.gov.

Chesapeake Bay Water Quality and Habitat Monitoring Program

Monitoring is vital to understanding environmental problems, developing strategies for managing the Bay's resources, and assessing progress of management practices. The purpose of the Chesapeake Bay Program (CBP) Water Quality and Habitat Monitoring Program is to assess trends in water quality and living resources throughout the Virginia portion of the Bay. The productivity, diversity, and abundance of living resources are the ultimate measures of the Chesapeake Bay's condition. Monitoring these organisms along with standard chemical (e.g. nutrients) and physical indicators of water quality can help determine the conditions that must be established and maintained to ensure the well being of the Bay's resources.

A general description of the monitoring program is:

- Water quality monitoring at 38 stations on the Rappahannock, York and James Rivers;
- Water quality monitoring at 27 stations in the Chesapeake Bay mainstem;
- Water quality monitoring and estimates of nutrient loading at "River input" stations on the James, Appomattox, Mattaponi, Pamunkey, and Rappahannock Rivers;
- Monitoring of phytoplankton and zooplankton communities in the mainstem of the Chesapeake Bay at 7 stations and in the tributaries at 6 stations;
- Monitoring of benthos communities in the Bay and its tributaries at 19 fixed stations and 100 random stations per year.

Chesapeake Bay Environmental Status and Trends Summary

Table 6.7-1 presents the use support summary for the mainstem Chesapeake Bay. Under the assessment rules used, a total of 83% (1265.4 sq. miles) of the mainstem Bay does not fully support the aquatic life use. The majority of this impairment is due to oxygen depletion (Table 3-2). This square mileage number is misleadingly large because the majority of this impairment is actually located in a relatively small volume of water in the deep water of the northerly part of the Virginia Chesapeake Bay. It is expected that when refined and scientifically based designated use areas are formally adopted for future assessments that this impaired square mileage will be greatly reduced. The secondary cause for impairment is biological integrity assessments based upon analysis of the benthic macroinvertebrate community (Table 6.7-2). A total of 391 sq. miles is impaired because of this. This benthic biologically impaired area does overlap some of the area impaired by depleted oxygen but also includes areas such as Tangier and Pocomoke sounds, which are not especially depleted of oxygen.

Table 6.7-1 (Units: SQUARE MILES)

USE	Total Size	Size Fully Supporting	Size Not Supporting	Size Not Assessed	Size with Insufficient Info
Aquatic Life	1522.42	257.02	1265.4	0	0
Fish Consumption	1522.42	970.4	0	552.02	0
Recreation	1522.42	0	0	1522.42	0
Shellfishing	1520	1520	0	0	0
Wildlife	1522.42	0	0	1522.42	0

Table 6.7-2 (Units: SQUARE MILES)

Impairment	Total Size
BIOLOGIC INTEGRITY (BIOASSESSMENTS)	391
OXYGEN DEPLETION	1089.4

This remainder of this section presents a very general overview of selected non-regulatory water quality conditions in the tidal portions of the Virginia Chesapeake Bay, and its major tributaries (i.e., Potomac, Rappahannock, James, and York Rivers). Much more comprehensive and detailed analyses are available for each major Bay basin (i.e. James, York, Rappahannock) by contacting the Chesapeake Bay Office of the Department of Environmental Quality. Water quality conditions are presented here through a combination of the current status and long-term trends for nutrients (nitrogen and phosphorus), chlorophyll, water clarity, suspended solids, and dissolved oxygen. These are the water quality conditions discussed most directly affected by nutrient and sediment reduction strategies.

The Virginia Chesapeake Bay and its tidal tributaries continue to show environmental trends indicating progress toward restoration to a more balanced and healthy ecosystem. However, the Bay system remains degraded and some areas and indicators show continuing degradation. Progress in reducing nutrient inputs has made demonstrable improvements and we expect that continued progress toward nutrient reduction goals, along with appropriate fisheries management and chemical contaminant controls, will result in additional improvements to the Bay. Findings from the last 18 years (1985 through 2002) of the monitoring programs are highlighted below and discussed further in the following sections.

- Nutrient loadings from watershed input monitoring stations are affected by these reduced point and non-point inputs but are highly dependant on river flow patterns as well. There have been decreased loadings of nitrogen, phosphorus, and sediments found at the James, Appomattox, and Mattaponi stations. Much of this decreased loadings is due to decreased riverflow but there have also been decreased loadings due to management actions.

- Phosphorus levels in water entering from the Bay watershed are reflecting both point and nonpoint source nutrient source reductions by showing improving concentration trends in some rivers. Within the tidal waters themselves, there is some improving areas observed but also some degrading areas. Overall, there were eight areas showing improving trends and five areas showing degrading trends for phosphorus.
- For nitrogen, the Potomac and James show improving trends in water entering from the watershed. Nitrogen levels also showed improving trends in much of the tidal Potomac, James, and Elizabeth Rivers. Improving trends have also been found for the first time in the mainstem Virginia Chesapeake Bay. Degrading trends are a concern in the upper Pamunkey and Rappahannock rivers. Overall, there were nineteen areas showing improving trends and only four areas showing degrading trends for nitrogen.
- Chlorophyll concentrations (an indicator of algae levels) are moderately high throughout much of the tidal waters. Degrading trends were found particularly in the tidal fresh portions of the rivers. Improving trends are being found only in the Potomac and Elizabeth Rivers. Overall, eight areas showed degrading trends in chlorophyll while two areas showed an improving trend. These results indicate nutrient concentrations are still too high despite relatively widespread improving trends in nitrogen.
- Levels of dissolved oxygen are improving in geographically widespread areas of the tidal rivers. However, an assessment of oxygen conditions in relation to recently developed criteria shows many areas of impairment. Overall, there were eleven areas showing improving trends and zero areas showing degrading trends for dissolved oxygen conditions. A preliminary assessment of new regulatory criteria for dissolved oxygen indicates fairly widespread non-attainment.
- Water clarity, a very important environmental parameter, was generally poor and degrading trends were detected in many areas. This degradation is probably related to scattered areas of increasing levels of suspended solids. These degrading conditions are a major impediment to restoration of submerged aquatic vegetation (SAV). Overall, there were six areas showing improving trends and ten areas showing degrading trends in water clarity. A preliminary assessment of new regulatory criteria for water clarity indicates fairly widespread non-attainment.
- The Elizabeth River is showing improving trends in all major water quality parameters.
- In summary, there are generally improving conditions for nitrogen and dissolved oxygen. Conversely, phosphorus, chlorophyll, suspended solids, and water clarity are generally declining. These patterns are a combined result of both management controls of nutrient inputs and the natural effects of rainfall (e.g. the drought which ended in 2004).

Monitoring of water quality conditions is vital to understanding environmental problems, developing management strategies, and assessing progress. This section summarizes results of statistical analyses conducted on surface concentrations of total nitrogen, total phosphorus, chlorophyll, water clarity, total suspended solids and bottom measurements of dissolved oxygen. These parameters are measures of water quality that are directly influenced by changes in nutrient loading and that in turn directly affect living resources of the Bay.

Nutrients such as nitrogen and phosphorus influence the growth of phytoplankton in the water column. Elevated concentrations of these nutrients often result in excessive phytoplankton production (i.e., chlorophyll). Decomposition of the resulting excess organic material during the summer can result in low levels of dissolved oxygen in bottom waters. These low oxygen levels (anoxic or hypoxic events) can cause fish kills and drastic declines in benthic communities which are the food bases for many fish populations. Anoxic waters also adversely affect fish and crab population levels by limiting the physical area available where these organisms can live.

Phosphorus: Figure 6.7-1 presents current status and long term trends in phosphorus concentrations. Areas of the Elizabeth, lower James, and York have the poorest conditions in relation to the rest of the Chesapeake Bay system. Other furthest downstream segments of rivers are fair but the mainstem Chesapeake Bay and the upper portions of the tidal rivers have relatively good conditions.

The “watershed input” stations shown in Figure 6.7-1 provide information about the success of nutrient control efforts. Results at these watershed input monitoring stations are flow-adjusted in order to remove the effects of river flow and assess only the effect of nutrient management actions (e.g., point source discharge treatment improvements and BMPs to reduce non-point source runoff).

The watershed input station in the largest Virginia tributary (James) shows improving concentration trends. Unfortunately, improving trends that were noted in last years report at the Mattaponi and Rappahannock watershed input stations were no longer present this year and also the degrading trends for Pamunkey and Potomac watershed inputs are still present.

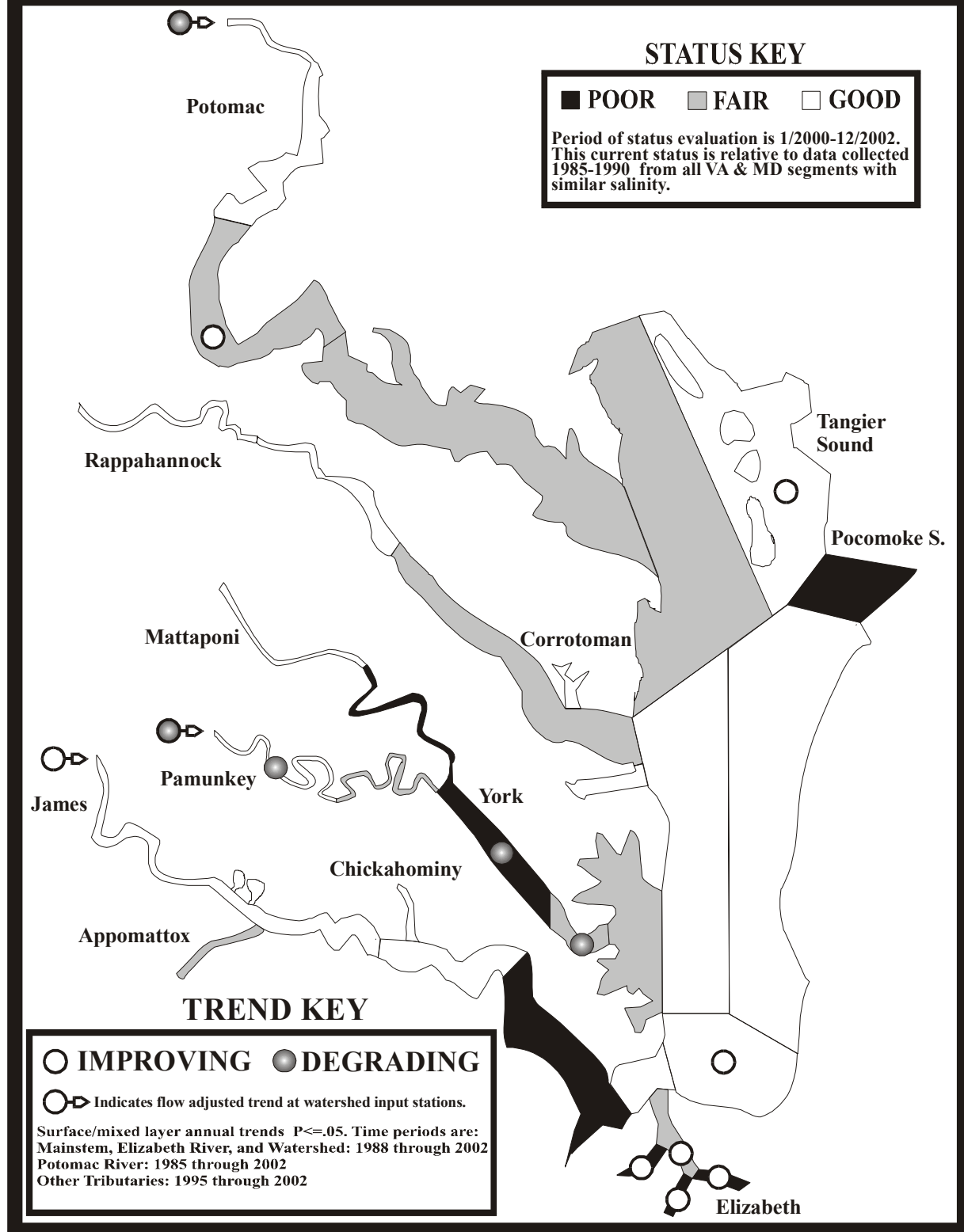
The Mattaponi, James, and Appomattox rivers all showed declining trends in loads of phosphorus this year. These loads are highly dependent on river flow and the declining trends are partly due to the three-year drought from 1999 through 2002. The load reductions are also a result of the phosphate detergent ban as well as implementation of BMPs for the control of non-point sediment and nutrient runoff.

The degrading trend in phosphorus at the Pamunkey watershed input station and degrading trends in the Pamunkey and York rivers suggesting management efforts to control phosphorus runoff have not been as effective in this basin. Improving conditions for phosphorus in the Elizabeth River mirrors the improving trends of other major water quality conditions in the Elizabeth system. Though not indicated in figure 1, there were many areas of degrading phosphorus trends in the Rappahannock and James observed during 1985 through 1993. These trends are no longer present in the 1995 through 2002 time period.

The terms good, fair, and poor used in conjunction with nitrogen and phosphorus conditions are statistically determined classifications for comparison among areas of similar salinity within the Chesapeake Bay system. Though useful in comparing current conditions among different areas of the Chesapeake Bay system, it must be remembered that these terms are not absolute evaluations but only appraisals relative to other areas of a generally degraded system. Several major scientific studies have shown that the Chesapeake Bay system is currently nutrient enriched and has excessive and detrimental levels of nutrient and sediment pollution. Given this, it is likely that an absolute evaluation in relation to ideal conditions would indicate that most water quality parameters are currently poor throughout the whole Bay system.

The Monitoring Subcommittee of the Federal-Interstate Chesapeake Bay Program continues to develop additional methodologies for water quality status evaluations, which in the future will be used in conjunction with, or possibly in replacement of, the current methods.

Figure 6.7-1) Phosphorus Status and Trends



Nitrogen: Figure 6.7-2 presents status and long term trends in nitrogen concentrations. As with phosphorus, management actions to reduce nitrogen have been effective as indicated by improving trends at the Potomac River and James River watershed input stations. However, also as with phosphorus, flow-adjusted concentrations of nitrogen are degrading in the Pamunkey River.

The Mattaponi, James, and Appomattox rivers all have declining trends in loads of nitrogen. These loads are highly dependent on river flow and the declining trends are partly due to the three-year drought from 1999 through 2002. The load reductions are also a result of implementation of BMPs for the control of non-point sediment and nutrient runoff as discussed previously in section II.

The improving trend of nitrogen at the watershed input station of the Potomac River as well as large reductions from point sources in the Washington, D.C. area has resulted in improving trends in several tidal areas of that river. Much of the tidal James River has improving nitrogen trends as a result of declining loads at the river input station as well as controls on the many point sources in the Richmond-Hopewell and Hampton Roads areas. Most of the Virginia Chesapeake Bay and Elizabeth River also have improving trends in nitrogen.

Status of nitrogen in the upper Potomac River and parts of the Elizabeth River is worse than status in the other major tributaries (Rappahannock, York, and James) and the Virginia Chesapeake Bay. Much of the Rappahannock River, York River, James River, and Virginia Chesapeake Bay have good relative status.

Chlorophyll: Chlorophyll is a measure of the level of algal biomass (i.e., phytoplankton) in the water. High chlorophyll or algal levels are indicators of poor water quality because they can lead to low dissolved oxygen conditions when the organic material sinks into bottom waters and is decomposed. High algal levels can also be a factor in reduced water clarity which decreases available light required to support photosynthesis in Submerged Aquatic Vegetation (SAV). High algal levels also can be indicative of problems with the food web such as decreased food quality for some fish (e.g., menhaden) and shellfish (e.g., oysters). Finally, high levels of chlorophyll may be indicative large-scale blooms of toxic or nuisance forms of algae.

Figure 6.7-3 presents the current status and long term trends in chlorophyll concentrations. Parts of all of the major Virginia tributaries have poor status in relation to Bay-wide conditions.

Degrading trends in chlorophyll were detected in the upper tidal fresh portions of the Potomac, Rappahannock, James, and Appomattox rivers. The only improving trends were observed in the lower Potomac River and part of the Elizabeth River.

Dissolved Oxygen: Bottom dissolved oxygen is an important factor affecting the survival, distribution, and productivity of living resources in the aquatic environment. Figure 6.7-4 presents the current status and long term trends in dissolved oxygen concentrations. Status is given in relation to dissolved oxygen levels supportive or stressful to living resources. About half of the Virginia Chesapeake Bay and smaller portions of the tidal tributaries had only fair status. The lower Potomac River, lower Rappahannock River, lower York River, and northernmost Virginia Chesapeake Bay segments are indicated as poor or fair partly because of low dissolved oxygen concentrations found in the mid-channel trenches. These mid-channel trenches have naturally lower dissolved oxygen levels and the spatial and temporal extent of low dissolved oxygen levels has been exacerbated by anthropogenic nutrient inputs.

There are scattered areas of improving conditions for dissolved oxygen and no areas of degrading trends. All of the tributaries have areas of improving conditions. These improvements are a result of both the nutrient management efforts and natural factors. The major natural factor has been the long-term (i.e. 1985 through 2003) declining riverflow at the watershed input stations of the Rappahannock, Pamunkey, Mattaponi, James, and Appomattox rivers. This in turn has lead to naturally less nutrient inputs and concurrently higher influxes of cleaner oceanic water.

Figure 6.7-2) Total Nitrogen Status and Trends

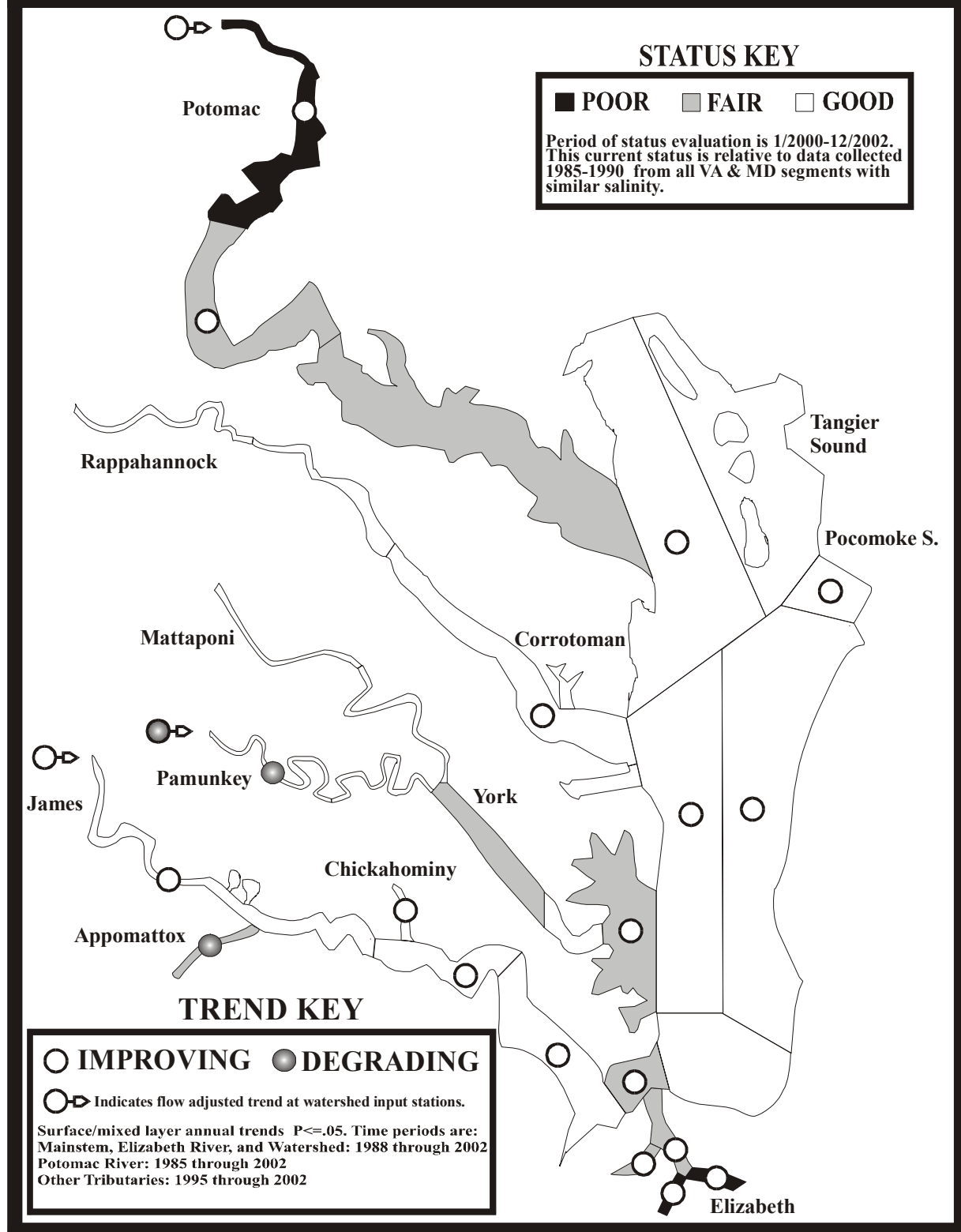


Figure 6.7-3) Chlorophyll Status and Trends

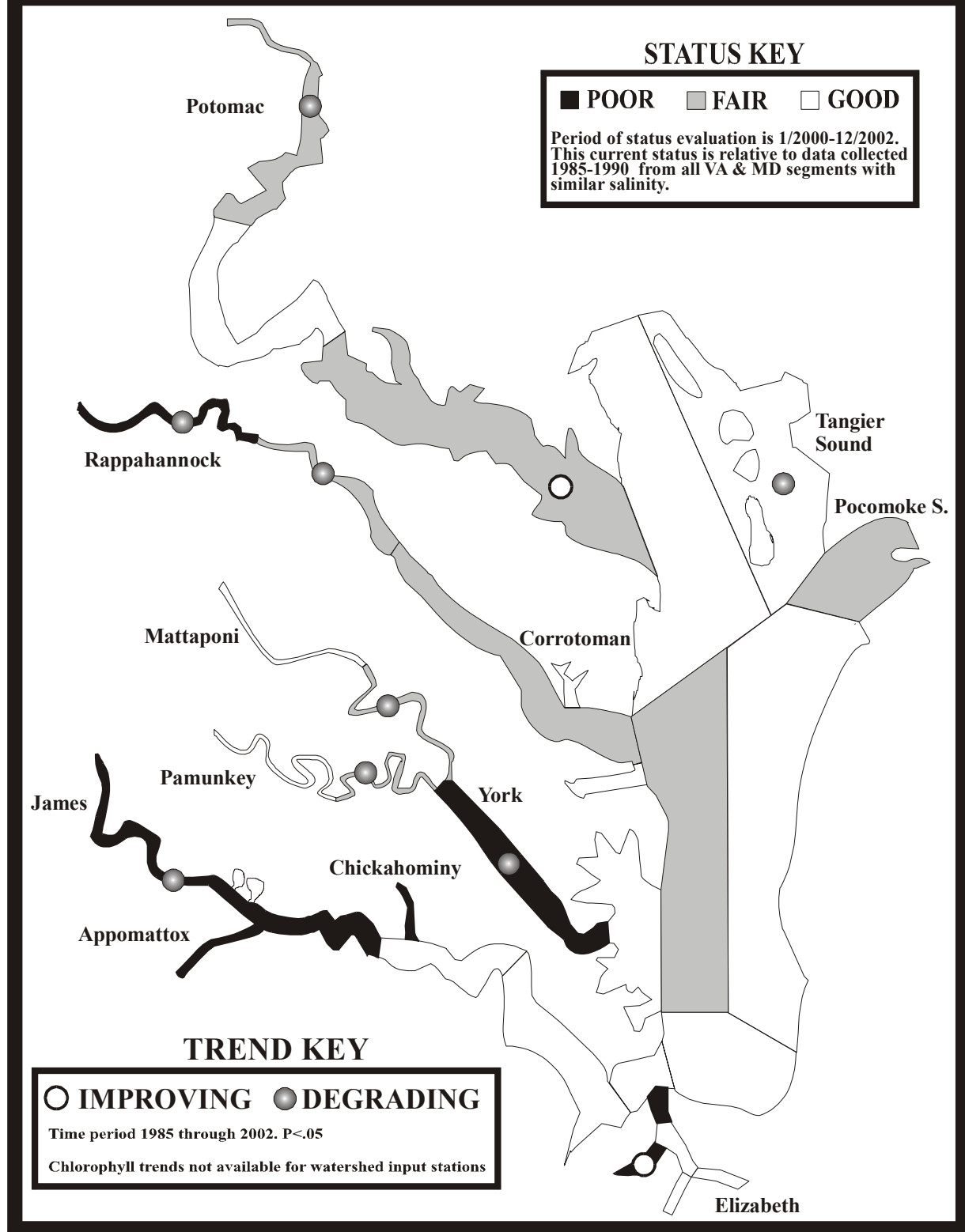
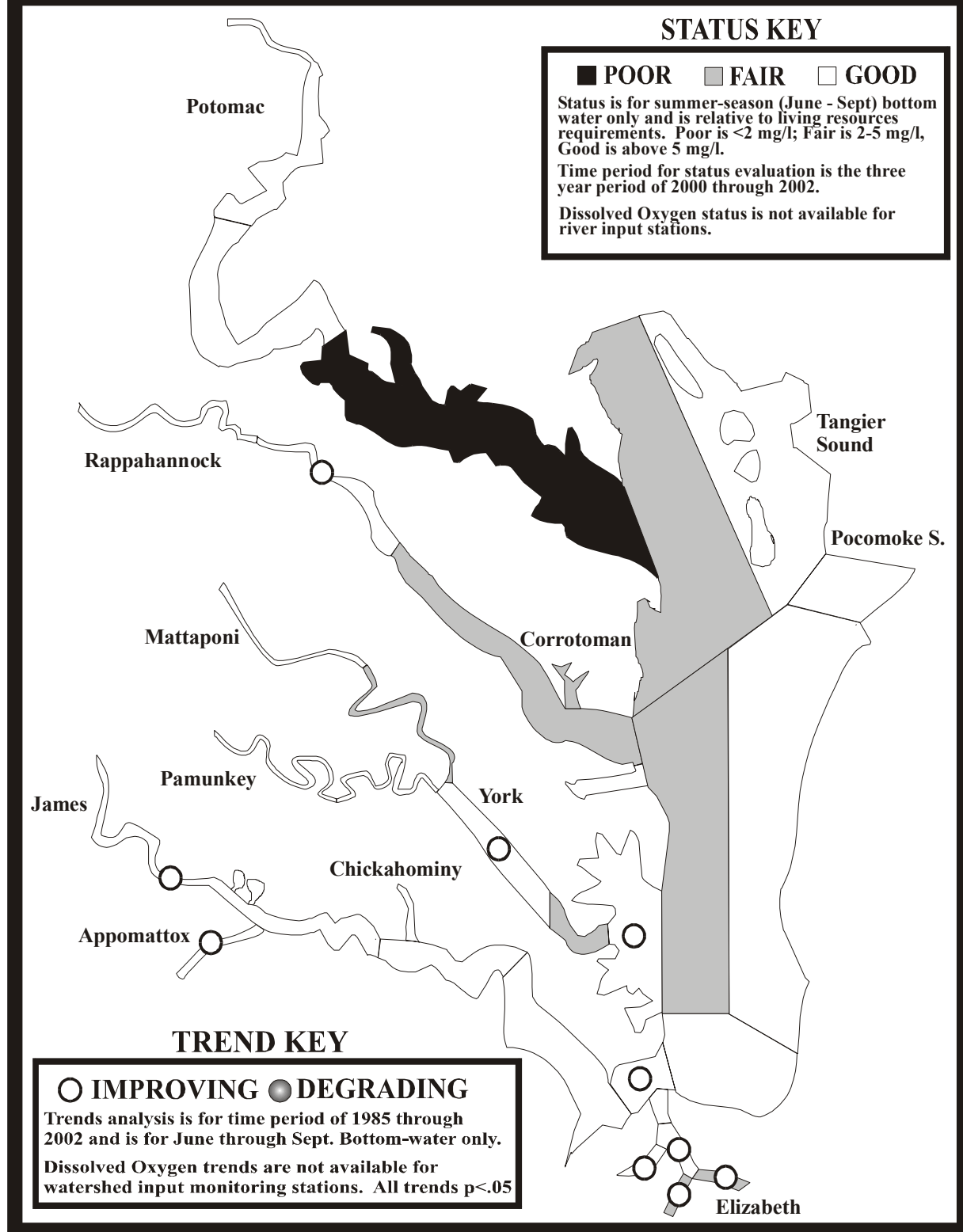


Figure 6.7-4) Dissolved Oxygen Status/Trends



Water Clarity: Water clarity is a measure of the depth to which sunlight penetrates through the water column. Poor water clarity is an indication that conditions are inadequate for the growth and maintenance of submerged aquatic vegetation (SAV). Poor water clarity can also affect the health and distributions of fish populations by reducing their ability to capture prey or avoid predators. The major factors that affect water clarity include: 1) concentrations of particulate inorganic mineral particles (i.e., sand, silt and clays), 2) concentrations of algae (i.e., phytoplankton), 3) concentrations of particulate organic detritus (small particles of dead algae and/or decaying marsh grasses), and 4) dissolved substances which “color” the water (e.g., brown humic acids generated by plant decay). Which of these factors most greatly influence water clarity varies both seasonally and spatially.

Figure 6.7-5 presents the current status and long term trends in water clarity. Status of many segments within the tributaries and the Chesapeake Bay mainstem are only fair or poor. This suggests that poor water clarity is one of the major environmental factors inhibiting the resurgence of SAV growth in Chesapeake Bay.

Degrading trends in water clarity were detected in segments located over a wide geographic area within the Virginia tributaries and Virginia Chesapeake Bay. These degrading trends represent a substantial impediment to the recovery of SAV beds within Chesapeake Bay. Possible causes of the degrading trends included increased shoreline erosion as a result of waterside development, loss of wetlands, increased abundance of phytoplankton, or a combination of sea level rise and land subsistence.

Suspended Solids: Suspended solids are a measure of particulates in the water column including inorganic mineral particles, planktonic organisms and detritus which directly controls water clarity for SAV. Elevated suspended solids can also be detrimental to the survival of oysters and other aquatic animals. Young oysters can be smothered by deposition of material and the feeding of filter feeding fish such as menhaden can be negatively affected by high concentrations of suspended solids. In addition, since suspended solids is comprised of organic and mineral particles that contain nitrogen and phosphorus or to which nitrogen and phosphorus compounds are adsorbed, increases in suspended solids can result in an increase of nutrient concentrations.

Figure 6.7-6 presents the current status and long term trends in suspended solids concentrations. All of the major Virginia tributaries have segments that are fair or poor. Improving trends in flow-adjusted concentrations at the watershed input stations of the Potomac River and the James River suggest that management actions to reduce NPS sediment loads may be working in these basins. However, several degrading trends in suspended solids concentrations were detected in some segments in both the tributaries and the Virginia Chesapeake Bay mainstem. The York River system (i.e. Mattaponi, Pamunkey, and York) has particularly widespread degrading conditions for suspended solids.

Figure 6.7-5) Water Clarity Status and Trends

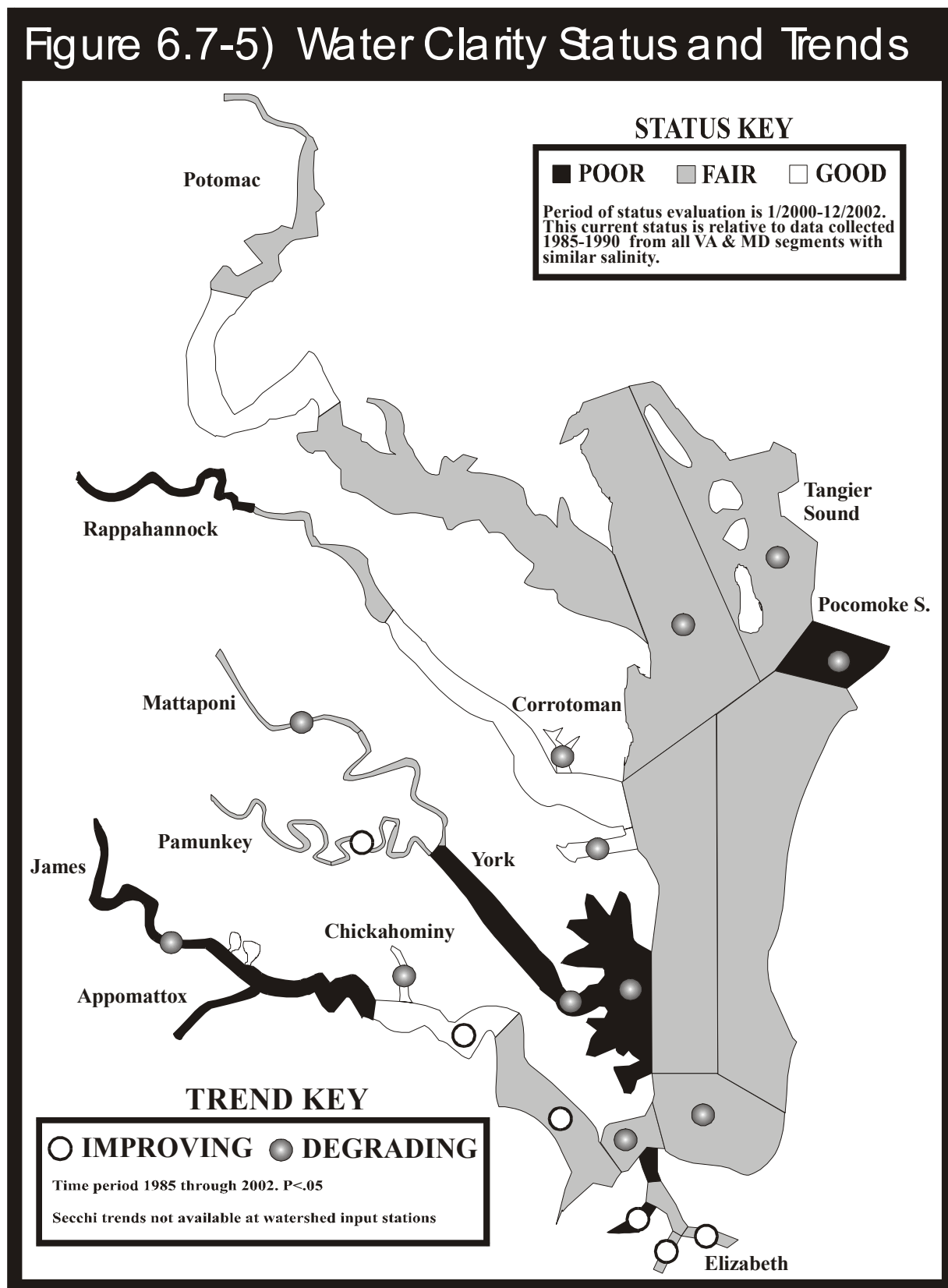
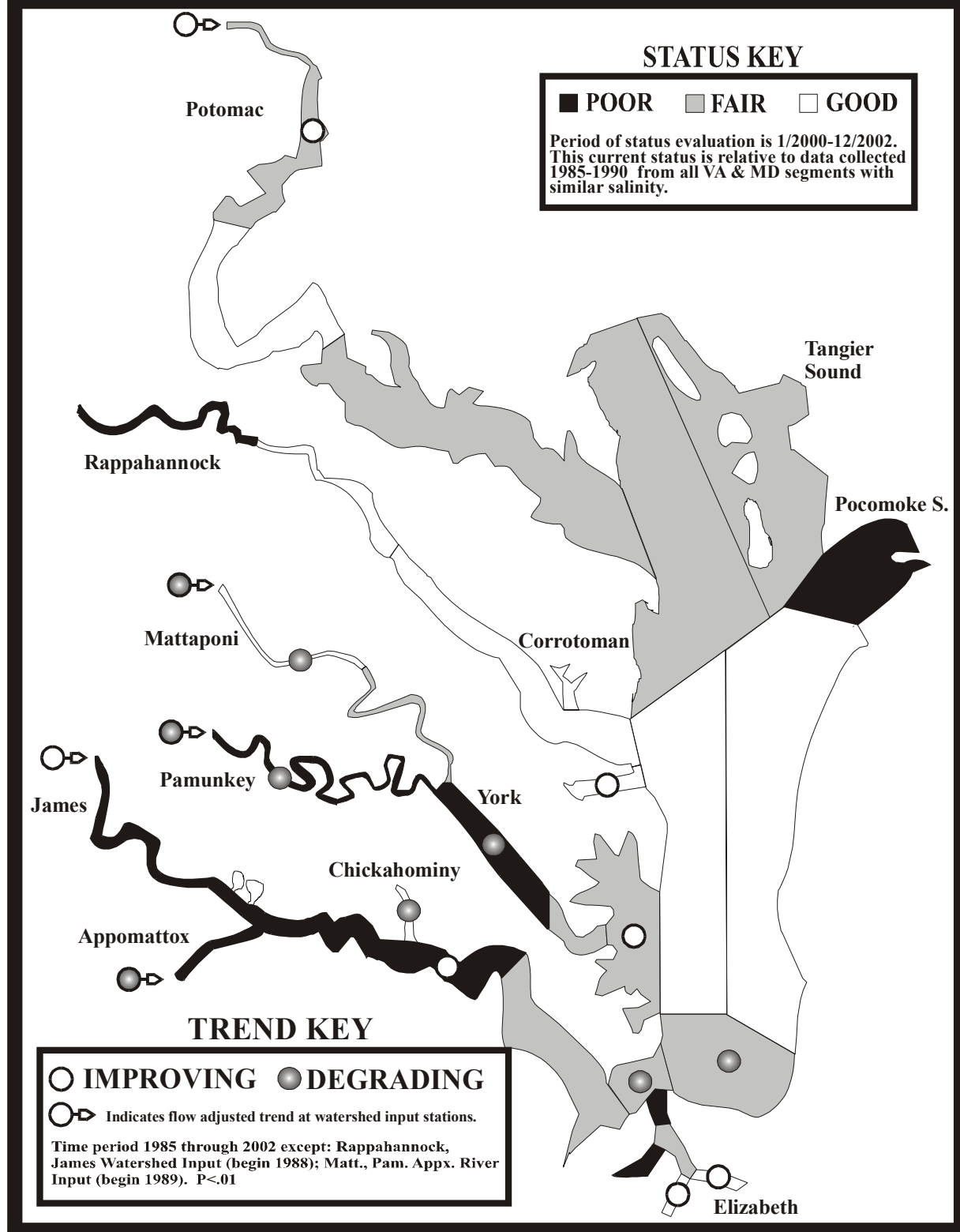


Figure 6.7-6) Suspended Solids Status/Trends



Toxic Contaminants: In 1999, the Chesapeake Bay Program's Toxics Subcommittee completed a toxics characterization (Figure 6.7-7 and Table 6.7-1) of the tidal tributaries of the Chesapeake Bay (U.S. EPA, 1999. Targeting Toxics: A Characterization Report. A Tool for Directing Management and Monitoring Actions in the Chesapeake Bay's Tidal Rivers. Chesapeake Bay Program, U.S. EPA 903-R-99-010, 1999, 49 pp. and appendices). The characterization served a dual purpose for the Chesapeake Bay Program and its partners: 1) it served as a guide in the development of the Toxics 2000 Strategy, and 2) it continues to provide the basis to direct management actions, such as toxics monitoring. The characterization process directed the placement of each pre-defined regional area into one of four categories based on chemical contaminant exposure and biological affects. Two contrasting areas include Regions of Concern which are highly impacted areas (e.g., Elizabeth River) and Areas of Low Probability for Adverse Effects which are regional areas where studies have been performed but there is no evidence to suggest living resources are impacted or threatened by chemical contaminants. The third grouping, Areas of Emphasis, are areas where data points to the potential for serious chemical contaminant-related impacts to living resources. Lastly, Areas of Insufficient or Inconclusive Data are those areas where the evidence from a particular segment is insufficient to place it into one of the three categories above.

Table 6.7-1 1999 Chemical Contaminant Characterization Results

VIRGINIA TIDAL TRIBUTARIES	TOXICS CHARACTERIZATION RESULTS
James River	Tidal Upper Segment: Area of Insufficient Data Tidal Middle Segment: Area of Insufficient Data Tidal Lower Segment: Area of Emphasis
York River	Tidal Pamunkey: Area of Insufficient Data Tidal Mattaponi: Area of Insufficient Data Upper Middle York: Area of Insufficient Data Lower Middle York: Area of Low Probability for Adverse Effects Upper Mobjack Bay: Area of Low Probability for Adverse Effects Lower Mobjack Bay: Area of Insufficient Data
Rappahannock River	Tidal Upper: Area of Low Probability for Adverse Effects Tidal Middle: Area of Insufficient Data Tidal Lower: Area of Low Probability for Adverse Effects
Potomac River (western shore)	Tidal Upper: Area of Emphasis Tidal Middle: Area of Emphasis Tidal Lower: of Low Probability for Adverse Effects

Source: Targeting Toxics: A Characterization Report, A Tool for Directing Management and Monitoring Actions in the Chesapeake Bays Tidal Rivers EPA 903-R-99-010, CBP/TRS 222/106, June 1999

Results from Recent Chemical Contaminant Monitoring in Areas of Insufficient Data not available in 1999:

Upper and Middle Tidal James River – Ambient Toxicity monitoring was completed during early fall in 2000 and 2001 in the tidal freshwater James River. In the first study year, twenty (20) stations were randomly located from Jamestown Island to the Benjamin Harrison Bridge near Hopewell. Full chemical contaminant analyses of the water column and sediment along with ambient toxicity tests, in-situ assays and benthic community assessments (sediment quality triad) were performed. (Roberts, M.H. Jr, M. A. Vogelbein, M. A. Richards, L. Seivard, and P. F. De Lisle. 2002. Chemical and Toxicological Characterization of Tidal Freshwater Areas in the James River, Virginia. Final Report to EPA Chesapeake Bay Program. 123 pp + Appendices). To enhance spatial coverage, a sediment quality triad approach (chemical contaminants, toxicity tests and benthic analysis) was performed on the James River between Hopewell and Richmond during the fall of 2001. (Roberts, M.H. Jr, M. A. Vogelbein, M. A. Richards, L. Seivard, and P. F. De Lisle. 2002. Chemical and Toxicological Characterization of Tidal Freshwater Areas in the James River, Virginia Between Jordan Point and Richmond. VA Department of Environmental Quality. 49 pp +Appendices). A total of nine (9) stations were included with the placement of eight (8) in the James River and one (1) in the Appomattox River.

The 2000 water column results plus data from 2 years of sediment study suggest there may be a low incidence of chemical contaminants causing deleterious biological impacts in this stretch of the James

River. The observance of low chemical contaminant levels and the lack of toxicological impacts at almost 30 random stations support this conclusion. Benthic community impacts were observed but for reasons other than chemical contaminants. While this effort was designed to make statements about the entire segment, conclusions from this study cannot rule out the possibility of locally impacted areas. Furthermore, this study was not designed to measure the bioaccumulative impacts of PCBs to fish and other biota although PCBs were on the targeted analyte list.

A Chesapeake Bay Program sponsored study performed a sediment quality triad survey at five (5) stations in the middle tidal segment of the James River near the confluence of the Chickahominy River. The authors suggested this segment could be characterized as an Area of Low Probability for Adverse Effects due to chemical contaminants (McGee, B. L., D.J. Fisher, J. Ashley, D. Velinsky. 2001. Using the Sediment Quality Triad to Characterize Toxic Conditions in the Chesapeake Bay (1999): An Assessment of the Tidal River Segments in the Bohemia, Magothy, Patuxent, Potomac, James, and York Rivers. U.S. EPA 903-R-01-008. Chesapeake Bay Program Office, Annapolis, MD, 2001, 35 pp. and appendices).

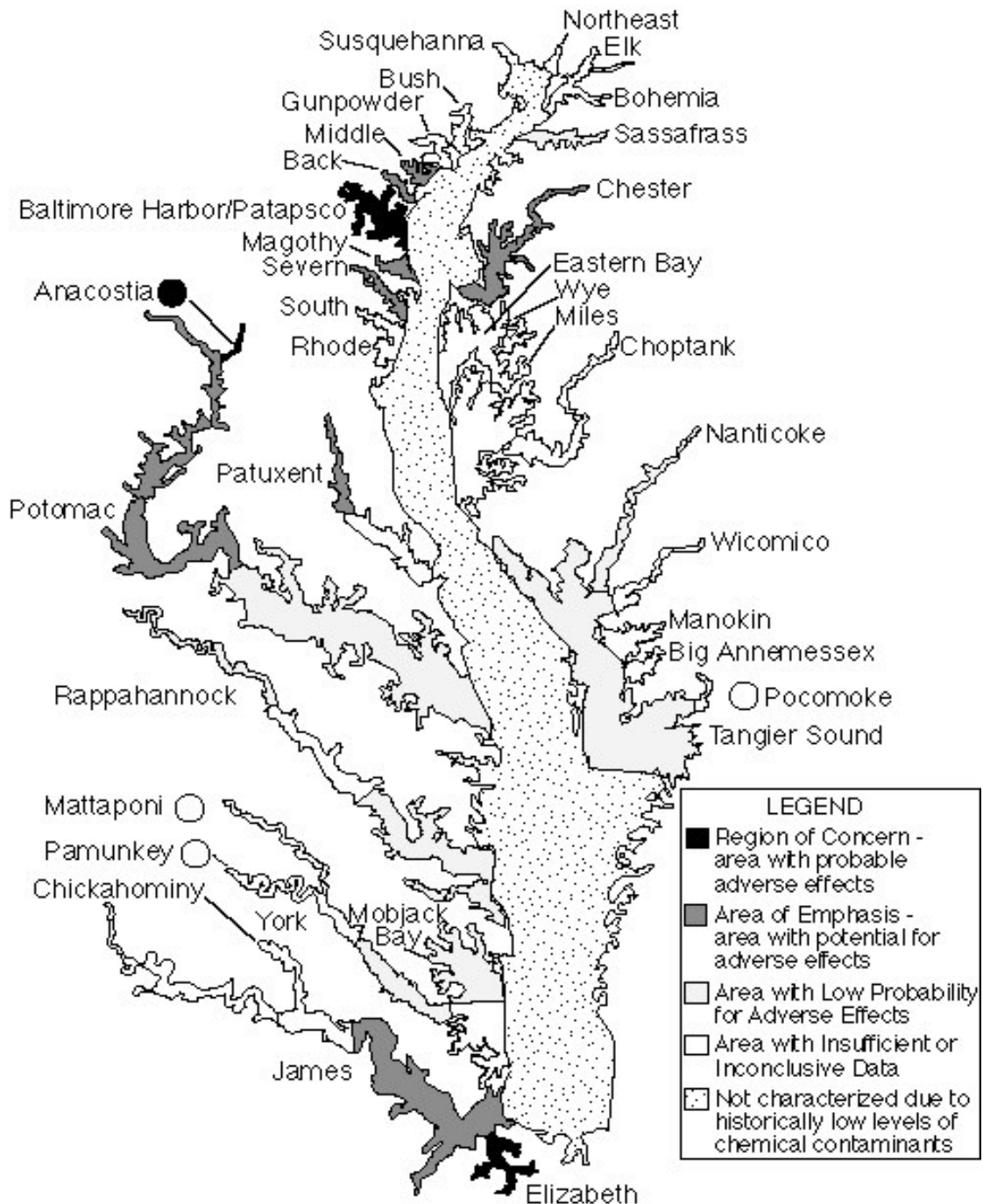
- Lower Mobjack Bay, including the Tidal Back and Poquoson Rivers – This area was sampled during fall 2002 by DEQ. Following a similar station selection design to earlier years, three (3) strata were identified with the selection of four (4) random stations within each stratum. The strata were defined as the Back River, Poquoson River, and the Mouth of the York River/Chesapeake Bay. As described above, the sediment quality triad approach was again used, as this has become the preferred tool for performing these characterizations. (Roberts, M.H. Jr, M. A. Richards, and P. F. De Lisle. 2003. Chemical and Toxicological Characterization of the Lower Mobjack Bay, York River, Virginia Segment of the Chesapeake Bay. Draft Final to the VA Department of Environmental Quality. 47 pp +Appendices).

The triad results show that degraded benthic communities were found in the Back and Poquoson Rivers, but the impact was described as being related to a eutrophic condition (i.e., nutrient enrichment). This was supported by low level chemical contaminants detected in sediments well below threshold levels predictive of a biological response. Additionally, lack of toxicological responses within the toxicity tests provides further evidence chemical contaminants are not the likely cause of the benthic stress.

- Upper Middle York River – As part of the McGee et al. study mentioned previously, a sediment quality triad (chemical contaminants, toxicity tests, benthic analysis) survey was performed at five (5) stations in the Upper Tidal York River. The conclusion from this study suggests this segment could be characterized as an Area of Low Probability for Adverse Effects due to low levels of chemical contaminants, with the caveat there may be localized impacts.
- Tidal Mattaponi and Pamunkey Rivers - In continuing the ambient toxicity-monitoring program, DEQ performed the field portion of a sediment quality study during the fall of 2003. Seven (7) randomly selected stations were targeted in both water bodies, ranging from their respective mouths to the upstream head of tide. The completion of this study should provide adequate information to the Chesapeake Bay Program such that full characterization can be made within this Bay segment. The full results with conclusions will be available by summer 2004.
- Tidal Middle Rappahannock River – A toxics assessment on the Middle segment of the tidal Rappahannock River was conducted during the fall of 1998 (Hall L.W. et al., Ambient Toxicity Testing in Chesapeake Bay – Year 9 Report. Draft, U.S. EPA, Chesapeake Bay Program Office, Annapolis MD, 2000, 88 pp. and appendices). This study targeted ten (10) stations with an approach that included water column and sediment toxicity tests, chemical analyses of both media, all in conjunction with fish and benthic community assessments. The results in this segment were mixed. While half the stations showed no impacts due to chemical contaminants, potential problems were observed at the remaining stations. Water Quality Criteria exceedences for metals occurred at two stations. In addition, there was evidence of varying degrees of ambient toxicity and benthic impairment although it was difficult to correlate the observed effects with chemical contaminants. Follow-up study is recommended to confirm the results at selected stations.

Figure 6.7- 7

Status of Chemical Contaminant Effects on Living Resources in the Chesapeake Bay's Tidal Rivers



The Elizabeth River

The Elizabeth River, a tidal tributary of the James River, is the major deep-water port of the Hampton Roads Harbor. The river system drains over 300 square miles in southeastern Virginia within the cities of Chesapeake, Norfolk, Portsmouth, and Virginia Beach. The Elizabeth River serves as the focal point for military activities, industry, and commerce in the Hampton Roads area. The watershed is among the most heavily urbanized and industrialized areas in the state.

In 1993, the Chesapeake Bay Program identified the Elizabeth River system as a Region of Concern as it is one of the most highly polluted bodies of water in the entire Bay watershed. In March 1995, the Commonwealth of Virginia entered into an agreement with the Elizabeth River Project (ERP), a private nonprofit organization, to recommend actions toward an Elizabeth River Regional Action Plan for Toxics Reduction. ERP, a Norfolk-based partnership of citizens, industry, governments, military, and recreational interests, had independently formed to develop an integrated watershed action plan for management of ecological and human health risk.

Water quality monitoring for toxic pollutants and their effects has continued on the Elizabeth River. Results from the period of 1999-2001 have been included in the report entitled "State of the River 2003" by the Elizabeth River Project. More recent monitoring that was not available for inclusion in the State of the River 2003 report is as follows:

- Benthic Index of Biotic Integrity (B-IBI) – A study of macrobenthic community health was initiated during the summer of 1999 in the Elizabeth River watershed and performed yearly thereafter. The results from the probability based sampling design (i.e., random) estimated the area of bottom communities not meeting the Chesapeake Bay Restoration Goal Index (RGI = 3) at 76% in 2002, 52% in 2001, 72% in 2000 all compared to the 1999 baseline of 64.3%. Research has suggested the observed impact may be due to sediment chemical contaminants.
- TBT Monitoring – Tributyltin (TBT) data have been collected at 18 stations in the Elizabeth River, Hampton Roads and the lower James River six times a year since 1999. With the exception of the Southern Branch, average ambient values typically range from one to ten times the chronic water quality criterion (1 ng/L) in the Elizabeth River. During the 2001 and 2002 monitoring events, average concentrations consistently exceeded 10 ng/L TBT at two stations on the Southern Branch.